(19) Japan Patent and Trademark Office (JP)
(12) Patent Gazette (B1)
(11) Patent No. 3403722 (P3403722)
(45) Issued: May 6, 2003
(24) Registered: February 28, 2003

(51) Int Cl.[7]	ID No.	F I	
B 09 C 1/06		C 02 F 11/10	ZABA
B 09 B 3/00		F 23 G 5/00	115B
C 02 F 11/10	ZAB	7/14	
F 23 G 5/00	115	G 21 F 9/02	551E
7/14		9/30	519A

No. of Claims 21(9 pages in original) Continued on last page

(21) Application No. 2002-78026 (P2002-78026)

(22) Submitted March 20, 2002

Examination Requested April 24, 2002

Application Subject to Accelerated Examination

(73) Patentee 500121126
ISV Japan Co., Ltd.
16 Ichiban-cho, Chiyoda-ku, Tokyo, Japan

(72) Inventor Toshiaki YASUFUKU
3-6-1 Kita Kuboji-cho, Chuo-ku, Osaka-shi, Osaka-fu, Japan

(72) Inventor Takahiko TERADA
1978-2 Ohaza Ogushi, Ube-shi, Yamaguchi-ken, Japan

(72) Inventor Kazuya KIGAWADA
515-1 Karima Aza Nishimuko, Tsukuba-shi, Ibaraki-ken, Japan

(74) Agent 100074675
Yasuo YANAGIGAWA, Patent Attorney

Examiner Tadahiro MAMADA

Continued on last page

(54) [Title] Hazardous substance treatment method using soil vitrification

(57) [Claims]

[Claim 1] A method for decomposition treatment of organic compounds using soil vitrification that includes a process wherein a layer of granular fireproof material is formed on the inside surface of a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, and comprises a bottom plate and side panels that are detachably

disposed on said bottom plate, a filling process wherein said container is filled with soil that has been contaminated with organic compounds, a hot melting process wherein said soil is heated and melted, said organic compounds are pyrolyzed, and said decomposition product is removed as a gas, and a cooling and extraction process wherein the molten soil is cooled into a vitrified mass, and then removed from the heat resistant container after removing the side panels of said heat resistant container from the bottom plate and breaking up the aforementioned granular fireproof layer.

[Claim 2] A method for decomposition treatment of organic compounds using soil vitrification that includes a process wherein a layer of granular fireproof material is formed on the inside surface of a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, and comprises a bottom plate and side panels that are detachably disposed on said bottom plate, a filling process wherein said container is filled with a solid that has been contaminated with organic compounds together with soil or a synthetic mineral, a hot melting process wherein said solid is heated and melted together with soil or a synthetic mineral, whereby the soil or a synthetic mineral is melted, said organic compounds are pyrolyzed, and the decomposition product is removed as a gas, and a cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass, and then removed from the heat resistant container after removing the side panels of said heat resistant container from the bottom plate and breaking up the aforementioned granular fireproof layer.

[Claim 3] A method for decomposition treatment of organic compounds using soil vitrification that includes a process wherein a layer of granular fireproof material is formed on the inside surface of a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, and comprises a bottom plate and side panels that are detachably disposed on said bottom plate, a filling process wherein said container is filled with a mixture of soil or a synthetic mineral and an organic compound or a liquid, granular substance, or mass that contains an organic compound, a hot melting process wherein the soil or synthetic mineral is melted and said

organic compounds are pyrolyzed by heating said mixture, and the decomposition product is removed as a gas, and a cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass, and then removed from the heat resistant container after removing the side panels of said heat resistant container from the bottom plate and breaking up the aforementioned granular fireproof layer.

[Claim 4] The method for decomposition treatment disclosed in any of claims 1 through 3, wherein each of the filling process, hot melting process, and cooling and extraction process is executed after moving the heat resistant container and disposing it at a mutually different location.

[Claim 5] The method for decomposition treatment disclosed in claim 4, wherein two or more heat resistant containers are prepared and the filling process, hot melting process, and cooling and extraction process are executed in parallel.

[Claim 6] The method for decomposition treatment disclosed in claim 4 or 5, wherein the heat resistant container is equipped with wheels.

[Claim 7] The method for decomposition treatment disclosed in claim 6, wherein said heat resistant container is moved by means of the wheels installed on the heat resistant container to the locations where the filling process, hot melting process, and cooling and extraction process are executed.

[Claim 8] The method for decomposition treatment disclosed in any of claims 1 through 3, wherein hot melting of the soil in the hot melting process is performed using Joule heat generated by flowing an electrical current between two or more electrodes embedded in the soil.

[Claim 9] The method for decomposition treatment disclosed in claim 8, wherein hot melting of the soil in the hot melting process is performed using a hot melt device that is installed and attached to the ground, and comprises two or more columnar electrodes to supply electrical current to the soil, a hood to cover the opening in the heat resistant container, and an electrical energy supply device that supplies electrical current to said electrodes.

[Claim 10] The method for decomposition treatment disclosed in claim 9, wherein the hood possesses an exhaust port, and a process is included wherein

the decomposition product of the organic compound discharged from the exhaust port is heat-treated.

[Claim 11] The method for decomposition treatment disclosed in any of claims 1 through 3, wherein the granular fireproof layer is formed of a granular fireproof substance selected from a group comprising silica sand, crushed rock, and composite ceramic.

[Claim 12] A method for immobilizing radioactive material using soil vitrification that includes a process wherein a layer of granular fireproof material is formed on the inside surface of a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, and comprises a bottom plate and side panels that are detachably disposed on said bottom plate, a filling process wherein said container is filled with a solid that has been contaminated with radioactive material together with soil or a synthetic mineral, a hot melting process wherein the soil or synthetic mineral is melted by heating said solid together with the soil or synthetic mineral, and a cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass and said radioactive material is sealed in said vitrified mass, which is then removed from the heat resistant container after removing the side panels of said heat resistant container from the bottom plate and breaking up the aforementioned granular fireproof layer.

[Claim 13] The immobilization method disclosed in claim 12, wherein each of the filling process, hot melting process, and cooling and extraction process is executed after moving the heat resistant container and disposing it at a mutually different location.

[Claim 14] The immobilization method disclosed in claim 13, wherein two or more heat resistant containers are prepared and the filling process, hot melting process, and cooling and extraction process are executed in parallel.

[Claim 15] The immobilization method disclosed in claim 13 or 14, wherein the heat resistant container is equipped with wheels.

[Claim 16] The immobilization method disclosed in claim 15, wherein said heat resistant container is moved by means of the wheels installed on the heat

resistant container to the locations where the filling process, hot melting process, and cooling and extraction process are executed.

[Claim 17] The immobilization method disclosed in claim 12, wherein hot melting of the soil or synthetic mineral in the hot melting process is performed using Joule heat generated by flowing an electrical current between two or more electrodes embedded in the soil or synthetic mineral.

[Claim 18] The immobilization method disclosed in claim 17, wherein hot melting of the soil or synthetic mineral in the hot melting process is performed using a hot melt device that is installed and attached to the ground, and comprises two or more columnar electrodes to supply electrical current to the soil or synthetic mineral, a hood to cover the opening in the heat resistant container, and an electrical energy supply device that supplies electrical current to said electrodes.

[Claim 19] The immobilization method disclosed in claim 12, wherein the granular fireproof layer is formed of a granular fireproof substance selected from a group comprising silica sand, crushed rock, and composite ceramic.

[Claim 20] A heat resistant container for hot melting soil or synthetic mineral, which comprises a bottom plate and side panels that are detachably disposed on said bottom plate, and is equipped with wheels on said bottom plate.

[Claim 21] The heat resistant container disclosed in claim 20, wherein a granular fireproof layer made from a granular fireproof material is formed on the inside surfaces.

[Detailed Description]

[0001]

[Pertinent Technical Field] This invention pertains to a method for decomposition treatment of organic compounds using soil vitrification. This invention also pertains to a method for immobilizing radioactive material soil vitrification. This invention further pertains to a hot melt device that can be appropriately used in the hot melting of soil or synthetic mineral, and a heat resistant container that can be appropriately used to perform that hot melting.

[0002]

[Prior Art] In recent years, soil and solids contaminated with harmful substances that have a deleterious effect on people and the environment have become problematic. For example, soil and solids, such as incinerator ash and fly ash, etc., contaminated by the dioxins that are unintentionally produced as garbage is burned have become an environmental problem in areas surrounding municipal garbage incinerators. Soil contaminated by organic compounds previously used as agricultural chemicals, such as p,p′-dichlorodiphenyl-trichloroethane (DDT), etc., has also become a problem. Furthermore, the treatment of solids contaminated by radioactive material discharged from nuclear power plants (radioactive waste) has also become a problem.

[0003] Methods that employ soil vitrification are known as one way of treating the aforementioned soil and solids contaminated by organic compounds and radioactive waste. For example, a radioactive waste immobilization method is disclosed in Japan Kokai Patent Application No. H02-43847, in which two or more electrodes are embedded in soil in which radioactive waste has been buried, the soil is hot melted utilizing Joule heat generated by flowing electrical current between these electrodes, after which the molten soil is cooled to form a vitrified mass and the radioactive material in the radioactive soil is sealed in the vitrified mass.

[0004] As for soil contaminated with organic compounds, the soil is hot melted, the organic compounds are pyrolyzed, the decomposition product is removed as a gas, and the molten soil is cooled into a vitrified mass. The decomposition product of the organic compound is decontaminated by gas treatment equipment comprising a furnace, such as a thermal oxidizer, etc., a dust arrester-cleaner, such as a Venturi scrubber, etc., a HEPA filter, and activated charcoal filter, and then released into the atmosphere as a harmless gas (e.g., carbon dioxide). Additionally, in the case of solids contaminated by organic compounds, the contaminated solid is heated together with soil to melt the soil and pyrolyzed the organic compound.

[0005]

[Problems to be Solved] It is common to use soil vitrification to treat soil or solids contaminated by organic compounds, and solids contaminated by radioactive material, at the location of the contamination problem (in-situ). However, when this treatment is performed at each site where contamination is a problem, the time it takes to install the soil hot melt device, etc. is a problem. In particular, while it is common to install metal plates with low gas permeability around the contaminated soil to be treated in order to prevent volatilization and diffusion of the organic compound when performing decomposition treatment of organic compounds, there are also problems with the time required for this installation work.

[0006] The purpose of this invention is to provide an industrially utile method for the decomposition treatment of organic compounds that employs soil vitrification. Another purpose of this invention is to provide an industrially utile method of immobilizing radioactive material using soil vitrification. Yet another purpose of this invention is to provide a hot melt device that can be appropriately used in the hot melting of soil, and a heat resistant container that can be appropriately used in performing said hot melting.

[0007]

[Means of Solving Problems] This invention is a method for decomposition treatment of organic compounds using soil vitrification that includes a process wherein a layer of granular fireproof material is formed on the inside surface of a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, and comprises a bottom plate and side panels that are detachably disposed on said bottom plate, a filling process wherein said container is filled with soil that has been contaminated with organic compounds, a hot melting process wherein said soil is heated and melted, said organic compounds are pyrolyzed, and said decomposition product is removed as a gas, and a cooling and extraction process wherein the molten soil is cooled into a vitrified mass, and then removed from the heat resistant container. Soil in this invention refers to inorganic matter produced by the decomposition of rock, etc. on the surface of the earth, and may or may not contain organic matter, such as decayed matter, etc.

[0008] This invention is also a method for decomposition treatment of organic compounds using soil vitrification that includes a process wherein a layer of granular fireproof material is formed on the inside surface of a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, and comprises a bottom plate and side panels that are detachably disposed on said bottom plate, a filling process wherein said container is filled with a solid that has been contaminated with organic compounds together with soil or a synthetic mineral, a hot melting process wherein said solid is heated and melted together with soil or a synthetic mineral, whereby the soil or a synthetic mineral is melted, said organic compounds are pyrolyzed, and the decomposition product is removed as a gas, and a cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass, and then removed from the heat resistant container. Synthetic minerals in this invention refer to artificially manufactured minerals, an example of which would be zeolite.

[0009] This invention is also a method for decomposition treatment of organic compounds using soil vitrification that includes a process wherein a layer of granular fireproof material is formed on the inside surface of a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, and comprises a bottom plate and side panels that are detachably disposed on said bottom plate, a filling process wherein said container is filled with a mixture of soil or a synthetic mineral and an organic compound or a liquid, granular substance, or mass that contains an organic compound, a hot melting process wherein the soil or synthetic mineral is melted and said organic compounds are pyrolyzed by heating said mixture, and the decomposition product is removed as a gas, and a cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass, and then removed from the heat resistant container.

[0010] It is preferred in the decomposition treatment method for organic compounds of this invention that each of the filling process, hot melting process, and cooling and extraction process be executed after the heat resistant container be moved and disposing it at mutually different locations.

It is also preferred that two or more heat resistant containers be prepared and the filling process, hot melting process, and cooling and extraction process be executed in parallel. In this case, it is preferred that the heat resistant container be equipped with wheels, and that the heat resistant container be moved by means of wheels to the locations at which the filling process, hot melting process, and cooling and extraction process will be executed.

[0011] It is preferred the decomposition treatment method of this invention that hot melting of the soil in the hot melting process be performed using Joule heat generated by flowing an electrical current between two or more electrodes embedded in the soil. For example, it is preferred that hot melting of the soil in the hot melting process be performed using a hot melt device that is installed and attached to the ground, and comprises two or more columnar electrodes to supply electrical current to the soil, a hood to cover the opening in the heat resistant container, and an electrical energy supply device that supplies electrical current to said electrodes. When this hot melt device is used, it is preferred that the hood possesses an exhaust port, and a process is included wherein the decomposition product of the organic compound discharged from the exhaust port is heat-treated.

[0012] It is preferred in the decomposition treatment method of this invention that a container made from a base plate and side panels that are detachably disposed on said base plate, that a granular fireproof layer made from granular fireproof material be formed on the inside surfaces of said heat resistant container before the filling process, and that removal of the vitrified mass in the cooling and extraction process be performed by disassembling the base plate and side panels of said heat resistant container and breaking said granular fireproof layer into granular fireproof material.

[0013] This invention is also a method for immobilizing radioactive material using soil vitrification that includes a filling process, wherein a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, and comprises a bottom plate and side panels that are detachably disposed on said bottom plate, is filled with a solid that has been

contaminated with radioactive material together with soil or a synthetic mineral, a hot melting process wherein the soil or synthetic mineral is melted by heating said solid together with the soil or synthetic mineral, and a cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass and said radioactive material is sealed in said vitrified mass, which is then removed from the heat resistant container.

[0014] It is preferred in the radioactive material immobilization method of this invention as well that each of the filling process, hot melting process, and cooling and extraction process be executed after moving the heat resistant container and disposing it at a mutually different location. It is also preferred that two or more heat resistant containers be prepared and the filling process, hot melting process, and cooling and extraction process be executed in parallel. In this case, it is preferred that the heat resistant container be equipped with wheels, and that the heat resistant container be moved by means of wheels to the locations at which the filling process, hot melting process, and cooling and extraction process will be executed.

[0015] It is also preferred in the immobilization method of this invention that hot melting of the soil or synthetic mineral in the hot melting process be performed using Joule heat generated by flowing an electrical current between two or more electrodes embedded in the soil or synthetic mineral. For example, it is preferred that hot melting of the soil or synthetic mineral in the hot melting process be performed using a hot melt device that is installed and attached to the ground, and comprises two or more columnar electrodes to supply electrical current to the soil or synthetic mineral, a hood to cover the opening in the heat resistant container, and an electrical energy supply device that supplies electrical current to said electrodes.

[0016] It is further preferred in the immobilization method of this invention that a container made from a base plate and side panels that are detachably disposed on said base plate be used as the heat resistant container, that a granular fireproof layer made from granular fireproof material be formed on the inside surfaces of said heat resistant container

before the filling process, and that removal of the vitrified mass in the cooling and extraction process be performed by disassembling the base plate and side panels of said heat resistant container and breaking said granular fireproof layer into granular fireproof material.

[0017] This invention is further a hot melt device for the soil or synthetic mineral that is installed and attached to the ground, and comprises two or more columnar electrodes to supply electrical current to the soil or synthetic mineral filling the heat resistant container, an electrical energy supply device that supplies electrical current to said electrodes, and a hood to cover heat resistant container. It is preferred that the hood of this hot melt device be equipped with an air inlet port and exhaust port, and the hot melt device possess a gas treatment device that is equipped with an air supply device connected to said air inlet port and a furnace connected to said exhaust port.

[0018] This invention is further a heat resistant container for hot melting soil or synthetic mineral, which comprises a bottom plate and side panels that are detachably disposed on said bottom plate, and is equipped with wheels on said bottom plate. It is preferred that a granular fireproof layer made from a granular fireproof material be formed on the inside surfaces of this heat resistant container.

[0019]

[Embodiment] First, the decomposition treatment method for organic compounds of this invention will be explained. The organic compounds that are the object of decomposition treatment are not specifically limited in the method of this invention. The method of this invention is especially utile in the decomposition treatment of chlorine-containing organic compounds, typical examples of which could include organic chlorine agricultural chemicals, such as hexachlorobenzene (HCB), hexachlorocyclohexane (BHC), p,p'-dichlorodiphenyltrichloroethane (DDT), chlordane, and endrin, biphenyl polychloride (PCB), and dioxins.

[0020] One characteristic of the method of this invention is that hot melting of the soil is performed using a heat resistant container that is

moveably disposed on the ground and possesses and opening in its top. Therefore, a heat resistant container that can be advantageously used in the method of this invention will be described first, referring to the attached Figure 1 and Figure 2.

[0021] Figure 1 is a sectional diagram of one example of a heat resistant container with an opening in its top that can be advantageously used in the method of this invention. In Figure 1, the heat resistant container 1 comprises a bottom plate 2, side panels 3 that are detachably disposed on the bottom plate 2, and wheels 4 that are provided on the bottom plate 2.

[0022] It is preferred that the bottom plate 2 and side panels 3 of the heat resistant container 1 each be formed of a material with low gas permeability and high heat resistance and retention. Fireproof brick, fireproof castables, and various thermal insulators (e.g., ceramic fiber, calcium silicate, pearlite, rock wool, asbestos, diatomaceous earth, glass wool, magnesium carbonate), etc. can be given as examples of this material.

[0023] It is preferred that a granular fireproof layer made from granular fireproof material be formed on the inner surfaces of the heat resistant container 1.

[0024] An example of a heat resistant container with a granular fireproof layer formed on its inner surfaces is shown in Figure 2. In Figure 2, the granular fireproof layer 5 is fofmed by filling the space between the heat resistant container 1 and a cylindrical partition plate 6 with granular fireproof material. Silica sand (silicon dioxide powder), crushed rock, and composite ceramics can be listed as examples of granular fireproof materials. Of these, silica sand is preferred. Silica sand with a grain size of 0.05 to 5 mm is especially preferred.

[0025] The material of the cylindrical partition plate 6 is not specifically limited, as long as it has enough rigidity that it will not deform when filled with granular fireproof material. Paper, plastic, ceramic, wood, and metals such as steel can be listed as examples of such materials.

[0026] Next, the method of this invention will be explained, using soil that has been contaminated with a typical organic compound as an example of the object of its treatment, and referring to the attached figures.

[0027] The organic compound in the contaminated soil can be decomposition treated by a method including, e.g., processes (1) through (3), below.

(1) A filling process wherein a heat-resistant container, which is moveably disposed on the ground and possesses an opening in its top, is filled with contaminated soil.

(2) A hot melting process wherein the contaminated soil is hot melted, said organic compounds are pyrolyzed, and the decomposition product is removed as a gas.

(3) A cooling and extraction process wherein the molten soil is cooled into a vitrified mass, and then removed from the heat resistant container.

[0028] The filling process will be explained, referring to Figure 3. Figure 3 shows a sectional diagram of an example of a heat resistant container after the filling process. The heat resistant container 1 is supported by rails 7. The rails 7 are connected to the various execution locations for each process, viz., the filling process, hot melting process, and cooling and extraction process. Namely, the heat resistant container 1 can be moved to the execution location for each process by being moved on the rails 7.

[0029] In the filling process, the heat resistant container 1 is filled with contaminated soil 8. It is preferred that a covering soil layer 9 made from soil that contains substantively no organic compounds be formed on top of the contaminated soil 8, as shown in Figure 3. Agricultural soil on which organic chloride agricultural chemicals have been spread, soil surrounding factories that manufactured or used organic compounds, and soil surrounding municipal garbage incinerators can be listed as examples of the contaminated soil [8] that is the object of treatment in the method of this invention. It is preferred that the organic compound content in the contaminated soil be in the range of 0.01 to 50% by mass.

[0030] Additives may be added to the contaminated soil 8 to promote the pyrolysis reaction of the organic compound. For example, if the organic

compound that is the object of decomposition treatment is an organic compound that contains a chloride atom, it is preferred that one or a mixture of two or more of aluminum oxide (especially active alumina), zeolite, or aluminum hydroxide be added. Moisture will also promote the pyrolysis of organic compounds. Adding water or a compound that will generate water vapor when heated to the soil can be given as a method of causing moisture to be present in the soil. Water retentive substances, such as bentonite, etc., or metal hydroxides can be listed as examples of compounds that generate water vapor when heated. Sodium hydroxide, magnesium hydroxide, potassium hydroxide, and aluminum hydroxide can be listed as examples of metal hydroxides.

[0031] If the melting point (glass transition temperature) of the contaminated soil 8 is higher than the melting point of the granular fireproof layer 5, it is preferable to add an alkali metal compound or alkali earth metal compound, which acts as a melting point depressant for the soil. Sodium carbonate, magnesium carbonate, and potassium carbonate, and sodium hydroxide, magnesium hydroxide, and potassium hydroxide can be listed as examples of alkali metal compounds and alkali earth metal compounds. The amount of melting point depressant added to the soil is an amount to make the difference between the melting point (glass transition temperature) of the contaminated soil 8 and the melting point of the granular fireproof material 100°C or greater (preferably in the range of 200 to 300°C).

[0032] The covering soil layer 9 has the function of melting before the contaminated soil 8 and uniformly heating the entire surface of the contaminated soil 8. Providing the covering soil layer 9 makes melting of the contaminated soil 8 uniform and stable. The thickness of the covering soil layer 9 is generally in the range of 1 to 100 cm, preferably in the range of 10 to 60 cm. The composition of the soil used for the covering soil layer 9 is not specifically limited as long as it is soil that contains substantively no organic compounds. "Contains substantively no organic compounds" means that the organic compound content is less than 0.01% by mass.

[0033] The partition plate 6 may be heated together with the contaminated soil and melted or sintered in the subsequent hot melting process, but it is

preferred that it be removed ahead of time prior to implementing hot melting of the contaminated soil.

[0034] Next, the hot melting process will be explained, referring to Figure 4. Figure 4 shows a hot melt device that can be advantageously used in the method of this invention. The hot melt device 10 comprises two or more columnar electrodes 11 for supplying electrical current to the soil, an electrical energy supply device 12 that supplies electrical energy to the electrodes 11, and a hood 13a that covers the opening in the heat resistant container 1. The hood 13a is attached by a hood support 13b. The electrodes 11 are attached to a electrode hood device (not shown) so that their tips can be moved vertically.

[0035] The hood 13 is equipped with an air inlet port 14 and an exhaust port 15. An air supply device [16] is connected to the air inlet port 14. The air supply device [16] supplies room temperature or heated air (less than 800°C) to the air inlet port 14. A gas treatment device 17 is connected to the exhaust port [15]. The gas treatment device 17 comprises a furnace (thermal oxidizer) 18, a cooler-dust arrester-cleaner (Venturi scrubber) 19, a HEP filter 20, and an activated charcoal filter 21.

[0036] The electrodes are electrically connected to an initial conductivity resistance strip 22 buried in the covering soil layer 9 in order to convert electrical energy to thermal energy (Joule heat). Graphite and metals such as molybdenum can be listed as examples of the material of the electrodes 11. The material of the initial conductivity resistance strip 22 is not specifically limited, as long as it has the function of converting electrical energy to thermal energy (Joule heat). Graphite and mixtures of graphite and soil melting point depressants can be listed as examples. Alkali salts, such as sodium hydroxide and sodium carbonate, and glass flit can be listed as soil melting temperature depressants.

[0037] Installation of the hot melt device 10 on the heat resistant container 1 is performed, e.g., as follows. A heat resistant container 1, in which an initial conductivity resistance strip 22 has already been buried in the covering soil layer 9, is moved beneath the hood 13a of the hot melt

device 10. Next, the heat resistant container 1 is raised by a jack (not shown). Thus, the side panels 3 of the heat resistant container are brought in contact with the hood 13a, covering the opening of the heat resistant container with the hood 13a. Finally, the tips of the electrodes 11 are moved downward by an electrode feed device (not shown) so that electrical contact is made between the electrodes 11 and the initial conductivity resistance strip 22.

[0038] Hot melting of the soil is performed, e.g., as follows. Electrical energy sent from the electrical energy supply device 12 passes through the electrodes and is sent to the initial conductivity resistance strip 22. The initial conductivity resistance strip 22 converts the electrical energy to thermal energy (Joule heat). The soil in the covering soil layer 9 is heated and melted by this heat. The melting of the covering soil layer 9 increases the conductivity of the soil, and thereafter, by continuing to supply electrical energy, the soil melt zone expands downward, and the contaminated soil 8 melts. The decomposition product of the organic compound moves to the top of the heat resistant container together with water vapor in the soil, and is sent as exhaust gas from the exhaust port 15 in the hood 13a to the gas treatment device 17. When an organic compound is decomposition treated, the interior of the hood 13a is maintained at a temperature in the range of 300 to 800°C by hot air supplied from the air supply device [16] so that harmful substances, such as dioxins, etc., are not produced from the decomposition products of the organic compound.

[0039] The furnace 18 heats the exhaust gas to temperatures over 850°C (normally 900 to 1,000°C) for at least 2 seconds. Thus, organic compounds in the exhaust gas, such as un-decomposed volatilized gas, etc. from the organic compound, are oxidized and pyrolyzed. The cooler-dust arrester-cleaner 18 rapidly cools the exhaust gas heated by the furnace 18 to below 100°C, neutralizes the acidic gas contained therein, and removes particulates. The HEPA filter 20 and activated charcoal filter 21 further recover fine particulates in the exhaust gas. The exhaust gas treated by the gas treatment device 17 is then exhausted into the atmosphere.

[0040] Once the entire quantity of contaminated soil has been hot melted, the supply of electrical energy is stopped. The heat resistant container 1 and hood 13a are then separated.

[0041] Next, the cooling and extraction process will be explained, referring to Figure 5. Figure 5 schematically shows an example of the operation of cooling the molten soil, and then removing the resulting vitrified mass. In Figure 5, the bottom plate 2 and side panels 3 of the heat resistant container 1 are separated by a crane 23. The granular fireproof layer is broken up into the original granular fireproof material 5a. The vitrified mass 24 is then exposed to the outside.

[0042] Since the vitrified mass 24 is physically and chemically stable and substantively contains no organic compounds, it can be pulverized and used as recycled crushed rock, or the like. The granular fireproof material 5a can be reused as raw material for the granular fireproof layer formed in the heat resistant container.

[0043] When each of the filling process, hot melting process, and cooling and extraction process are executed at mutually different locations in this invention, it is preferred that two or more (preferably three or more) heat resistant containers be prepared and the filling process, hot melting process, and cooling and extraction process executed in parallel.

[0044] A embodiment of a method of decomposition treating organic compounds in contaminated soil by the parallel execution of the filling process, hot melting process, and cooling and extraction process is shown in Figure 6. Figure 6 shows an example in which the filling process, hot melting process, and cooling and extraction process are executed in parallel using three heat resistant containers 1a, 1b, 1c. The heat resistant containers 1a, 1b, 1c here are moved on rails 7 using wheels 4, but the method of moving the heat resistant containers is not specifically limited. For example, the heat resistant containers could be moved using a crane or lift, etc. Further, each of the filling process, hot melting process, and cooling and extraction process is normally performed inside a single facility, but the filling process could be executed at the site where the contaminated soil is.

[0045] The method of this invention has been explained above, using an example of contaminated soil, which is a typical example of the object of treatment, but solids contaminated by organic compounds, and liquids, granular substances, or masses of organic compounds, or containing organic compounds, can also be similarly treated.

[0046] In other words, organic compounds in contaminated solids can be decomposition treated by a method including, e.g., processes (1) through (3), below.

(1) A filling process wherein a heat-resistant container, which is moveably disposed on the ground and possesses an opening in its top, is filled with contaminated solids together with soil or a synthetic mineral.

(2) A hot melting process wherein the contaminated solids are hot melted together with the soil or synthetic mineral, and said organic compounds are pyrolyzed, and the decomposition product is removed as a gas.

(3) A cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass, and then removed from the heat resistant container.

[0047] It is preferred that the soil used here be soil that substantively contains no organic compounds, or in which the organic compound content is low. "Substantively contains no organic compounds" here means that the organic compound content is in the range of 0.01 to 1% by mass. Additives to promote pyrolysis of the organic compounds, water or compounds that produce water vapor when heated, and alkali metal compounds of alkali earth metal compounds may be added to the soil or synthetic mineral.

[0048] PCB-containing containers, combustion ash and fly ash exhausted from municipal garbage incinerators, fireproof material (bricks) from municipal garbage incinerators, and sludge discharged from factories that manufactured or used organic compounds can be given as examples of contaminated solids that are the object of treatment in this invention.

[0049] The organic compounds in liquids, granular substances, or masses that either are organic compounds or contain organic compounds can be

decomposition treated by a method including, e.g., processes (1) through (3), below.

(1) A filling process wherein a heat-resistant container, which is moveably disposed on the ground and possesses an opening in its top, is filled with a mixture of soil or synthetic mineral and a liquid, granular substance, or mass that either is an organic compound or contains an organic compound.

(2) A hot melting process wherein the soil or synthetic mineral is hot melted, and said organic compounds are pyrolyzed, and the decomposition product is removed as a gas.

(3) A cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass, and then removed from the heat resistant container.

[0050] It is preferred that the soil used here also be soil that substantively contains no organic compounds, or in which the organic compound content is low. Additives to promote pyrolysis of the organic compounds, water or compounds that produce water vapor when heated, and alkali metal compounds of alkali earth metal compounds may be added to the soil or synthetic mineral.

[0051] If the liquid, granular substance, or mass that either is an organic compound or contains an organic compound is in a container, with the method of this invention, the container itself can be mixed with soil and treated. For example, transformers or capacitors in which PCB is used can be mixed as is with soil and treated. Organic chloride agricultural chemicals (pesticides) can be listed as examples of liquids, granular substances, or masses that contain organic compounds that are the object of treatment in this invention.

[0052] Next, the method of immobilizing radioactive material of this invention will be explained. Radioactive waste discharged from a nuclear power plant can be listed as an example of a solid contaminated by a radioactive material (radioactive waste) that is the object of the treatment of this invention.

[0053] The radioactive material in radioactive waste, e.g., can be immobilized by a method including, e.g., processes (1) through (3), below.

(1) A filling process wherein a heat-resistant container, which is moveably disposed on the ground and possesses an opening in its top, is filled with radioactive waste together with soil or a synthetic mineral.

(2) A hot melting process wherein the radioactive waste is heated together with the soil or synthetic mineral, thereby melting the soil or synthetic mineral.

(3) A cooling and extraction process wherein the molten soil or synthetic mineral is cooled into a vitrified mass, sealing said radioactive material in said vitrified mass, and then removed from the heat resistant container.

[0054] The soil or synthetic mineral can be hot melted in the radioactive material immobilization method of this invention in the same manner as in the organic compound decomposition treatment method.

[0055] Further, cases have been explained up to now in which Joule heat was employed to hot melt the soil, but there is no particular limit to the method of hot melting the soil, as long as the soil with which the heat resistant container is filled can be step-wise heated or hot melted. For example, plasma could also be used to hot melt the soil.

[0056]

[Effect] The decomposition treatment method for organic compounds using soil vitrification of this invention can shorten the time required for treatment since it simplifies the operation of installing the hot melt device, etc. It is also possible with the method of this invention to perform continuous decomposition treatment of organic compounds by preparing two or more heat resistant containers and executing the filling process, hot melting process, and cooling and extraction process in parallel.

[Brief Explanation of the Figures]

[Figure 1] This is a sectional diagram of an example of a heat resistant container that can be advantageously used in the method of this invention.

[Figure 2] This is a sectional diagram of another example of a heat resistant container that can be advantageously used in the method of this invention.

[Figure 3] This is a sectional diagram of the heat resistant container after the filling process according to this invention.

[Figure 4] This is a diagram showing the condition in which the hot melt device used in the hot melting process is installed on the heat resistant container according to this invention.

[Figure 5] This is a drawing showing the operation for removing the vitrified mass from the heat resistant container in the cooling and extraction process according to this invention.

[Figure 6] This is a drawing schematically showing a embodiment of the method for decomposition treatment of organic compounds in contaminated soil according to this invention.

[Legend]

1, 1a, 1b, 1c … heat resistant container

2 … bottom plate

3 … side panels

4 … wheels

5 … granular fireproof layer

5a … granular fireproof material

6 … partition plate

7 … rails

8 … contaminated soil

9 … covering soil layer

10 … hot melt device

11 … electrodes

12 … electrical energy supply device

13a … hood

13b … hood support

14 … air inlet port

15 … exhaust port

16 … air supply device

17 ... gas treatment device

18 ... furnace

19 ... cooler-dust arrester-cleaner

20 ... HEPA filter

21 ... activated charcoal filter

22 ... initial conductivity resistance strip

23 ... crane

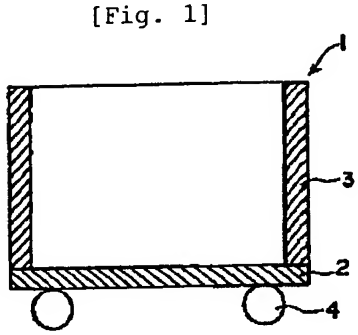
24 ... vitrified mass

[Abstract]

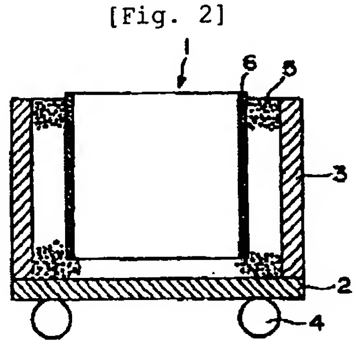
[Problem] To provide a decomposition treatment method used on organic compounds in soil that has been contaminated with organic compounds using soil vitrification.

[Means of Solution] A decomposition treatment method for organic compounds using soil vitrification that includes a filling process, wherein a heat-resistant container, which is moveably disposed on the ground, possesses an opening in its top, is filled with soil that has been contaminated a organic compound, a hot melting process wherein said soil is hot melted, said organic compound is pyrolyzed, and the decomposition product is removed as a gas, and a cooling and extraction process wherein the molten soil is cooled into a vitrified mass, and then removed from the heat resistant container.

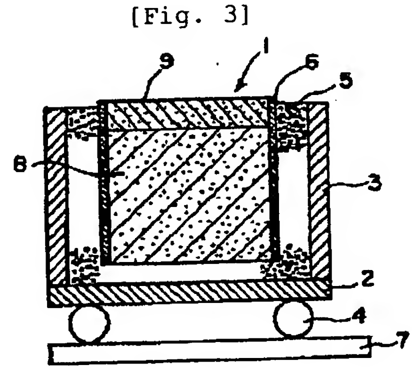
[Fig. 1]



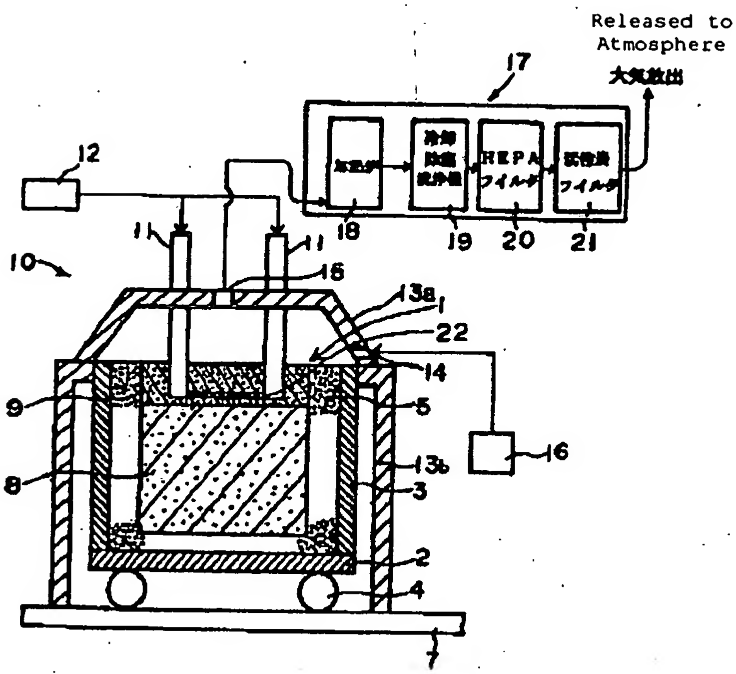
[Fig. 2]



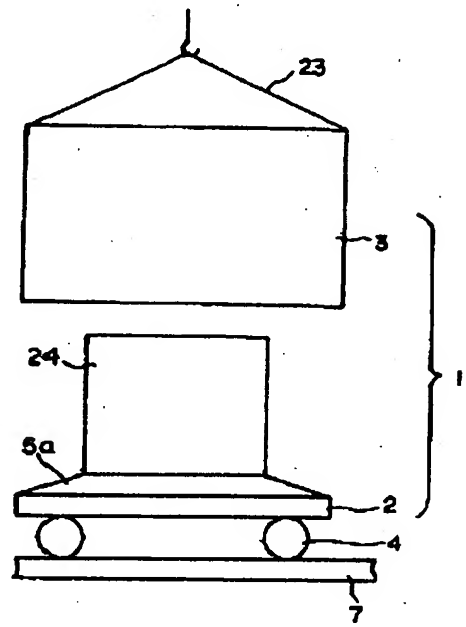
[Fig. 3]



[Fig. 4]

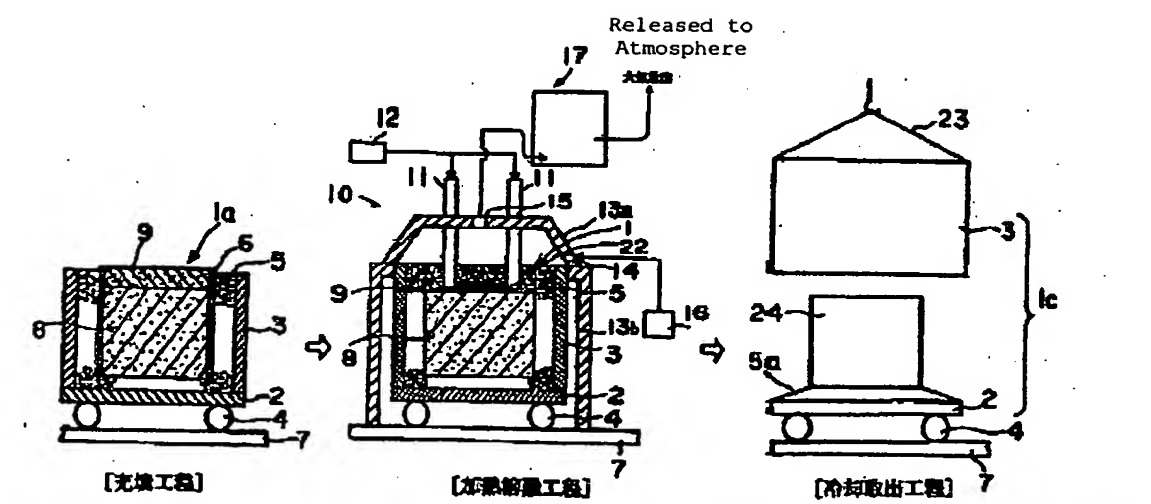


[Fig. 5]
【図5】



- Key -
18 ... Furnace
19 ... Cooler-Dust Arrester-Cleaner
20 ... HEPA Filter
21 ... Activated Charcoal Filter

[Fig. 6]



[Filling Process] [Hot Melting Process] [Cooling/Extraction Process]

Continued from front page

(51) Int Cl.^{7}	ID No.	F I	
G 21 F 9/02	551	G 21 F 9/30	551A
9/30	519	B 09 B 3/00	303P
	551		303L
			303Z

(56) Bibliography

Japan Kokai Patent Application No. 2002-71894 (JP, A)
Japan Kokai Patent Application No. 2001-62422 (JP, A)
US Patent No. 6120430 (US, A)
Kamoike Group JV: *Daiokishin rui osenbutsu no mugaika shori - Jiomeruto kouhou, kankyou shisetsu* [Decontamination treatment for dioxin contaminants - GioMelt Technique, Environmental Facilities], Japan, *K.K. Koukyou Sesshi Jaanaru* [Journal of Public Asset, Ltd.], 2001, No. 86, p. 32-34.

(58) Examined Fields (Int. Cl.^{7}, DB Name)

B09C 1/06
B09B 3/00
C02F 11/10
F23G 5/00
F23G 7/14
G21F 9/02
G21F 9/30
JICST File (JOIS)
WPI (DIALOG)